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TI Tin alloy solders for heat exchangers  
IN Kubota, Kohei; Ninomya, Ryuji; Myake, Koichi; Yamaguchi, Hiroshi  
PA Mitsui Mining & Smelting Co, Japan  
SO Jpn. Kokai Tokkyo Koho, 3 pp.  
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AB The Sn alloy solders contain 1-15% Zn and optionally  $\leq 3\%$  Cu. Alternatively, the solders contain Zn 1-15, Cu  $\leq 3$ , and Ag, In, Sb, Ni, Fe, and/or Bi  $\leq 5\%$ . The solders are useful for soldering of Cu alloy automobile radiators and heaters.

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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*\*).
2. Texts in the figures are not translated and shown as it is.

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**FULL CONTENTS**

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**[Claim(s)]**

[Claim 1] Copper and the solder alloy for the product heat exchangers made from a copper alloy which are characterized by consisting of Sn except for a remainder inevitable impurity Zn1 - 15wt%.

[Claim 2] Copper and the solder alloy for the product heat exchangers made from a copper alloy which are characterized by consisting of Sn except for less than Cu3wt% and a remainder inevitable impurity Zn1 - 15wt%.

[Claim 3] Copper and the solder alloy for the product heat exchangers made from a copper alloy which are characterized by consisting of Sn Zn1 - 15wt% except for less than more than 1 sort 5wt% and a remainder inevitable impurity at least among less than Cu3wt%, Ag, In, Sb, nickel, Fe, and Bi.

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**[Detailed Description of the Invention]****[0001]**

[Industrial Application] This invention relates to the solder alloy for heat exchangers used for the assembly for the heat exchangers the detailed radiator for automobiles made from copper and a copper alloy, for car heaters, etc. about the solder alloy for heat exchangers.

**[0002]**

[Description of the Prior Art] Generally the solder material of a Pb-Sn system is used for junction of the heat exchanger made from copper and a copper alloy. In the field of the car radiator or the car heater, Pb85 - 35wt%, the 2 yuan alloy of Remainder Sn is used and many 85 - 60wt% of things are used for a part especially for Pb.

[0003] However, when discarded [ that the heat exchanger using solder with much Pb is cut, or is not

carried out by shredder, either, or ] by the outdoors, Pb will be eluted in soil and is a prevention-of-pollution top problem. Moreover, the defect in which the junction between plate material and inner tube material etc. receives thermal stress, and carries out creep modification, severe corrosion in which the flower bloomed by the electric potential difference of brass and solder is caused, a fin separates or an inner tube explodes [ \*\*\*\* / causing leakage ] may be produced.

[0004]

[Problem(s) to be Solved by the Invention] Moreover, this invention is compared with Pb-Sn system solder excluding Pb which poses such a public nuisance top problem. It excels in hardness and creep strength, and the grade of the electric corrosion between brass makes it the final object to raise the reliability of heat exchangers, such as a car radiator and a car heater, for the purpose of offering few corrosion resistance outstanding solder alloys for heat exchangers.

[0005]

[Means for Solving the Problem] This invention is based on the knowledge of choosing an alloying element in detail in order to obtain the alloy which is damp in copper and a copper alloy with Sn alloy of Sn base, and gives spread nature, and attains the above-mentioned object.

[0006] That is, copper of this invention and the solder alloy for the product heat exchangers made from a copper alloy are characterized by consisting of Sn except for a remainder inevitable impurity Zn1 - 15wt%.

[0007] moreover, copper of this invention and the solder alloy for the product heat exchangers made from a copper alloy -- the above-mentioned presentation -- in addition, Cu -- less than 3wt% -- you may contain.

[0008] furthermore, copper of this invention and the solder alloy for the product heat exchangers made from a copper alloy -- Cu -- in addition, the inside of Ag, In, Sb, nickel, Fe, and Bi -- at least one or more sorts -- less than 5wt% -- you may contain.

[0009] Zn raises the hardness of a solder alloy and it is effective in lowering a fusing point. Moreover, creep strength is also raised. the content -- 1 - 15wt% -- it is 3 - 10wt% preferably. As for the effect, less than [ 1wt% ] is not enough as content, more than 15wt% covers [ content ] the expenses of a fusing point, and wet spread nature and corrosion resistance fall. Even if it adds further comparatively so much, it is rare to make electric potential into \*\* like Pb, and to promote electric corrosion with brass. When soldering for the object for electronic industry materials or electrical and electric equipment is assumed conventionally, Zn will wet wet if it is added, since weak activity flux is used, and I hear that its spread nature is not enough, and it has been used as a harmful element. However, since strong activity flux is used for the assembly of heat exchangers, such as a car radiator and a car heater, although wet spread nature falls a little compared with a Pb-Sn system, it is possible to secure the wet spread nature of an usable grade.

[0010] Since it is effective in suppressing the phenomenon in which the fin material which is the jointed material which creep strength is made to \*\* and is called what is called a solder \*\*\*\*\* phenomenon melts into solder, and becomes weak thinly, Cu can be made to contain arbitrarily. the content -- less than 3wt% -- it is 0.1 - 1wt% preferably. If content becomes more than 3wt%, the

flowability of solder material will fall and an activity will become difficult.

[0011] Ag, In, Sb, nickel, Fe, and Bi raise the hardness of solder material, respectively, and since it is effective in wetting wet and raising spread nature, In and Bi can be made to contain arbitrarily further. The content is less than 5wt%. If content exceeds 5wt%, the meaning which an effect is saturated and is made to contain more will be lost.

[0012]

[Example] Based on an example etc., this invention is explained concretely hereafter.

The alloy of an example 1-3 and 1-25 sorts of comparative examples was first ingoted as follows.

(1) Presentation : 8.9wt%Zn, Remainder Sn, fusing point:198 degree C (example 1).

(2) Presentation : 8.9wt%Zn, 0.5wt%Cu, Remainder Sn, fusing point:198 degree C (example 2).

(3) Presentation : 8.9wt%Zn, 0.5wt%Cu, 0.3wt%Sb, Remainder Sn, fusing point:198 degree C (example 3).

(4) Presentation : 72wt%Pb, Remainder Sn, fusing point:265 degree C (comparative example 1), (5) presentation: pure Sn, fusing point:232 degree C (comparative example 2).

In addition, the above-mentioned fusing point was respectively measured from each phase diagram.

[0013] Each was cast from a temperature higher 100 degrees C than the fusing point to the metal pattern, the round bar 20mm in diameter was obtained, and the piece of a mechanical test (sample offering sample) etc. was extracted.

[0014] \*\* As for the result of a tension test, examples 1 are the tensile strength of 77Ns/mm<sup>2</sup>, and 53% of elongation, As for the tensile strength of 77Ns/mm<sup>2</sup>, 49% of elongation, and an example 3, the tensile strength of 43Ns/mm<sup>2</sup>, 25% of elongation, and the comparative example 2 of the tensile strength of 78Ns/mm<sup>2</sup>, 46% of elongation, and a comparative example 1 were [ example 2 ] the tensile strength of 25Ns/mm<sup>2</sup>, and 55% of elongation.

[0015] \*\* The constant stress two of 4.7Ns/mm was hung under 130-degree C environment, and the amount of creep elongation was measured. The diameters of the load part were 2mm and 1.5mm of parallel parts. The example 1 was extended 67 hours afterward, as for 0.26mm elongation and an example 2, the result was extended 0.06mm 67 hours afterward, and although the example 3 was 0.04mm elongation 67 hours afterward, the comparative example 1-2 has been fractured within 67 hours.

[0016] \*\* From the fusing point, Cu70wt% and Zn30wt% of the brass plate which carried flux 0.4ml which consists of saturation ZnCl<sub>2</sub> solution, a solder metal, or 0.3g of alloys (sample offering sample) on the Sn-Pb bath set as the temperature on 50 degrees C was carried, it wetted wet, and spread nature was investigated. Although wet spread nature was most excellent in the comparative example 1, any solder metal or alloy was also in the good wet condition.

[0017] \*\* Hot dipping was respectively carried out to 3cm x 3cm of lower halves of the brass plate (3cm x 6cm) of four sheets with the solder metal or alloy (sample offering sample) of the example 1-3 and the comparative example 1-2, and it was immersed in the form where each brass plate is independently sunk in a 5%NaCl solution for 90 hours. After the check, the solder metal or the alloy was washed with sulfuric acid 10%, and corrosion weight loss was calculated. As for 31mg and an

example 3, the example 1 was [ corrosion weight loss / 30mg and example 2 / 50mg and the comparative example 2 of 30mg and a comparative example 1 ] 26mg. The bottom of the beaker which had immersed the comparative example 1 was notably covered with the white deposit.

[0018] \*\* The piece of brass 2 sheet was soldered with the solder metal or alloy of the example 1-3 and the comparative example 1-2, and the superposition joint of the 1cm angle was created. Since soldering conditions were made into the conditions held for 15 minutes at temperature with a fusing point of +50 degrees C, they are conditions from which an alloy layer develops. The ends of brass were pulled, lengthened and removed with the tensile testing machine, and the force was investigated. Since the hardness to which the soundness of an alloy layer, the shearing strength of a solder alloy, wet area, etc. mixed and were joined came out, physical meaning attachment was difficult, but in 2010N and an example 3, 2050N and a comparative example 1 were [ the example 1 / 1700N and an example 2 / 1690N and the comparative example 2 of the result ] 1980N.

[0019]

[Effect of the Invention] As explained above, it is Sn alloy solder of this invention, It excels in hardness and creep strength, there is also little corrosion by electric corrosion with brass, and since Pb is not included, when it uses for heat exchangers, such as a car radiator and a car heater, since the public nuisance by Pb is not caused but it is hard to cause accident, such as leakage of water, the heat exchanger whose reliability improved can be offered.

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[Translation done.]